

REMARKS

Claims 1-19 are in the case. Claims 1-3, 5-10, 12-16, 18, and 19 are rejected under 35 USC § 103(a) over Beerling (5,861,902). Claims 4, 11, and 17 are rejected 35 USC § 103(a) over Beerling ('902) in view of Haas et al. (5,143,577). The rejections are respectfully traversed. Reconsideration and allowance of the claims are requested.

A. CLAIMS 1-3, 5-10, 12-16, 18, AND 19 ARE PATENTABLY DISTINGUISHED OVER THE CITED REFERENCES.

As previously described, the claims are directed to substrates for micro-fluid ejection devices having characteristics that provide improved formation of fluid flow paths through the substrates. A deep reactive ion etching process is used to form the fluid flow paths through the substrate due to the thickness of the substrate and the length of the fluid flow path through the substrate. By providing an etching location in the substrate that has less than 5000 Angstroms thickness of a dielectric layer or a root mean square depth of surface pitting less than about 500 Angstroms, improved fluid flow paths may be formed by the deep reactive ion etching process according to the claimed invention.

In the rejection of claims 1-3, 5-10, 12-16, 18, and 19, the Examiner concedes that the '902 patent does not teach a deep reactive ion etching process for etching the substrate 12. The examiner asserts that the '902 patent teaches a "dry etching" process in a different embodiment. However, the dry etching process, described in the '902 patent, is limited to etching a thin dielectric layer 92 applied to a silicon dioxide layer 90, rather than etching the substrate 12 itself. The only etching process described in the '902 patent for etching the substrate 12 is an electrochemical etch process, not a dry etch process. The examiner relies on Wang et al. (U.S. Pat. Appl. No. 2002/01138) for teaching that dry etching and deep reactive ion etching are identical processes. However, that reliance, even if true, fails to teach or suggest etching a substrate with a deep reactive ion etching process as claimed.

Furthermore, deep reactive ion etching is a process that involves alternating between a passivating plasma step and an etching plasma step. Alternating between

plasma and etching allows deeper reactive etching sufficient to etch slot 40 through a relatively thick substrate 42 according to the claimed invention. The passivating plasma step protects the side walls of the slots during the etching process so that etching through the substrate occurs primarily on the surface perpendicular to the side walls of the slot.

The cited '577 patent reference refers to deep reactive ion etching and inductively coupled plasma etching as "dry etching". This is simply a shorthand notation used in conjunction with this particular application. There is nothing in the '577 patent that states that all dry etching is "deep reactive ion etching." Dry etching is commonly understood by those skilled in the art as including reactive ion etching and deep reactive ion etching. Hence, deep reactive ion etching is a subspecies of the generic or broader term "dry etching." Accordingly, dry etching, as it is commonly understood in the art, is not "identical to" or limited to deep reactive ion etching.

The foregoing distinction is significant because particular types of dry etching do not protect the vertical side walls of slots, whereas deep reactive ion etching includes a passivation step in order to protect the side walls of the slots as etching progresses through the substrate. In addition to the above deficiency of the '902 patent to suggest or disclose a deep reactive ion etching process, the '902 patent also fails to suggest or disclose etching fluid paths through a silicon substrate. Rather, the '902 patent refers to etching a "silicon substrate . . . to form a porous silicon portion which defines the thermal barrier island." Col. 8, lines. 2-4. The substrate (12' in FIGs. 3a-3g of the '902 Patent) is etched to form a porous thermal barrier island 16'. The substrate is not etched to form fluid paths, slots or vias through the substrate, as claimed. Furthermore, the '902 patent fails to suggest or disclose a substrate with a surface characteristic selected from a thin dielectric layer of no more than about 5000 Angstroms or a substantially dielectric-free pitted surface having a root mean square depth of surface pitting of less than 500 Angstroms with a maximum surface pitting depth of no more than about 2500 Angstroms. Since the '902 patent is manifestly deficient in suggesting or disclosing all of the elements of claims 1, 8 and 14, the 35 USC § 103(a) rejection is wholly untenable and should be withdrawn. Reconsideration and allowance of claims 1, 8, and 14 are respectfully requested.

Dependent claims 2, 3, 5-7, 9, 10, 12, 13, 15, 16, 18, and 19 depend from independent claims 1, 8, and 14, and contain additional important aspects of the invention. Therefore, dependent claims 2, 3, 5-7, 9, 10, 12, 13, 15, 16, 18, and 19 are patentable over '902 patent for the same reasons claims 1, 8, and 14 are patentable over the '902 patent. Reconsideration and allowance of dependent claims 2, 3, 5-7, 9, 10, 12, 13, 15, 16, 18, and 19 are respectfully requested.

B. CLAIMS 4, 11, AND 17 ARE PATENTABLY DISTINGUISHED OVER THE CITED REFERENCES.

The Examiner rejected Claims 4, 11, and 17 over the '902 patent in view of the '577 patent. Claim 4 depends from Claim 1, claim 11 depends from claim 8, and claim 17 depends from claim 14. Therefore the arguments set forth above with regard to the patentability of Claims 1, 8 and 14 are not repeated here but are respectfully asserted with regard to the rejection of Claims 4, 11, and 17. Particularly, the '902 patent does not suggest or disclose deep reactive ion etching an oxide free substrate having surface pitting ranging from less than about 500 Angstroms to no more than about 2500 Angstroms.

The Examiner concedes that the '902 patent fails to disclose a substrate wherein the "surface characteristic comprises a substantially oxide free pitted surface wherein a root mean square depth of surface pitting is less than about 500 Angstroms and a maximum surface pitting depth is no more than about 2500 Angstroms. The Examiner asserts that the '577 patent discloses the above limitations ". . . in order to create a smoother surface to simplify printing." As a preliminary observation, having a surface characteristic with a root mean square pitting depth of less than 500 Angstroms (as is claimed) provides advantages during a deep reactive ion etching process for etching fluid supply paths through the substrate to help improve substrate etching time and prevent "grassing" as discussed on p.6, lines. 20-35 and p. 7, lines 1-6 of the specification.

In stark contrast, the '577 patent relates to the field of optical waveguides consisting of a transparent wave-guiding core surrounded by transparent materials of lower indices of refraction. One method for forming optical waveguides involves applying a dielectric material to a transparent substrate of lower refractive index.

Nothing in '577 patent discusses printers, printheads, inkjet printheads, or a heater chip used to eject liquid, particularly ink, from an inkjet printhead with vias etched in a substrate for connecting the printhead to an ink supply. The technical field of the '577 patent is totally unrelated to the technical field of claimed invention for use in making micro-fluid ejection heads. Additionally, the '577 patent fails to suggest or disclose a substrate surface characteristic comprising a substantially oxide free pitted surface for etching fluid supply paths by deep reactive ion etching, but rather discloses a polymer thin film smooth-wall (channel optical waveguide surface which has a root mean square roughness less than about 10 nanometers) lining on its vertical wall surfaces to minimize optical loss by scattering of propagating wave energy. The surface characteristic of Applicant's invention is a result of etching the dielectric layer off of the substrate in preparation for DRIE etching the substrate. Whereas the surface characteristic of the '577 patent is created by etching away portions of cladding thin films and waveguiding layer to provide a free-standing polymeric channel waveguiding medium 13' on the substrate wafer 11. The waveguiding medium 13" is then lined by an optically transparent polymer thin film smooth-wall lining 15 to fills and smooth the sidewall roughness of the waveguiding medium 13". Thus, the "smooth-wall" lining is a surface characteristic of a waveguiding medium 13' on top of a substrate, but it is not a surface characteristic of the substrate itself.

Like the '902 patent, the '577 patent fails to suggest or disclose a deep reactive ion etching process or forming fluid supply paths in a substrate using a deep reactive ion etching process. Since both references have the same deficiency, the combination of the '902 patent and the '577 patent is also deficient and thus fails to provide all of the elements of the claimed invention. Accordingly, claims 4, 11, and 17 patentably define over the '902 patent in view of the '577 patent. Reconsideration and allowance of claims 4, 11, and 17 are respectfully requested.

COMBINATION OF REFERENCES

The MPEP outlines three conditions that must be met for a *prima facie* case of obviousness to be made out. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill

in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations. Since the combined references fail to provide all of the elements of the claimed invention as set forth above, there is no need to discuss motivation to combine the references or the expectation of success.

It is a requirement in making out a *prima facie* case of obviousness that all of the limitations of the claims must be taught or suggested by the cited references. However, the examiner has failed to find all of the claimed elements, or at least certain important aspects of the claimed elements. For example, neither '902 patent nor the '577 patent suggest or disclose deep reactive ion etching a substrate or forming fluid supply paths in the substrate by deep reactive ion etching. Accordingly, the examiner has failed to make out a *prima facie* case of obviousness.

CONCLUSION

Applicants assert that the claims of the present application patentably define over the prior art made of record and not relied upon for the same reasons as given above. Applicants respectfully submit that a full and complete response to the office action is provided herein, and that the application is now fully in condition for allowance. Action in accordance therewith is respectfully requested.

In the event this response is not timely filed, applicants hereby petition for the appropriate extension of time and request that the fee for the extension be charged to deposit account 12-2355. If other fees are required by this amendment, such as fees for additional claims, such fees may be charged to deposit account 12-2252.

Respectfully submitted,

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